Analysis of bacterial nitrogen fixation efficiencies aiding in system design for nutrient capture on mars

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Introduction

Biological nitrogen fixation (BNF) is an energetically demanding process carried out by the enzyme nitrogenase. BNF has recently received more attention as a process for sustainable fertilizer production. Due to the large number of nitrogen fixing bacteria and growth conditions, BNF system design is not a trivial process. We are attempting to identify growth analysis methods that we can utilize for system design to maximize the nitrogen fixing rates.

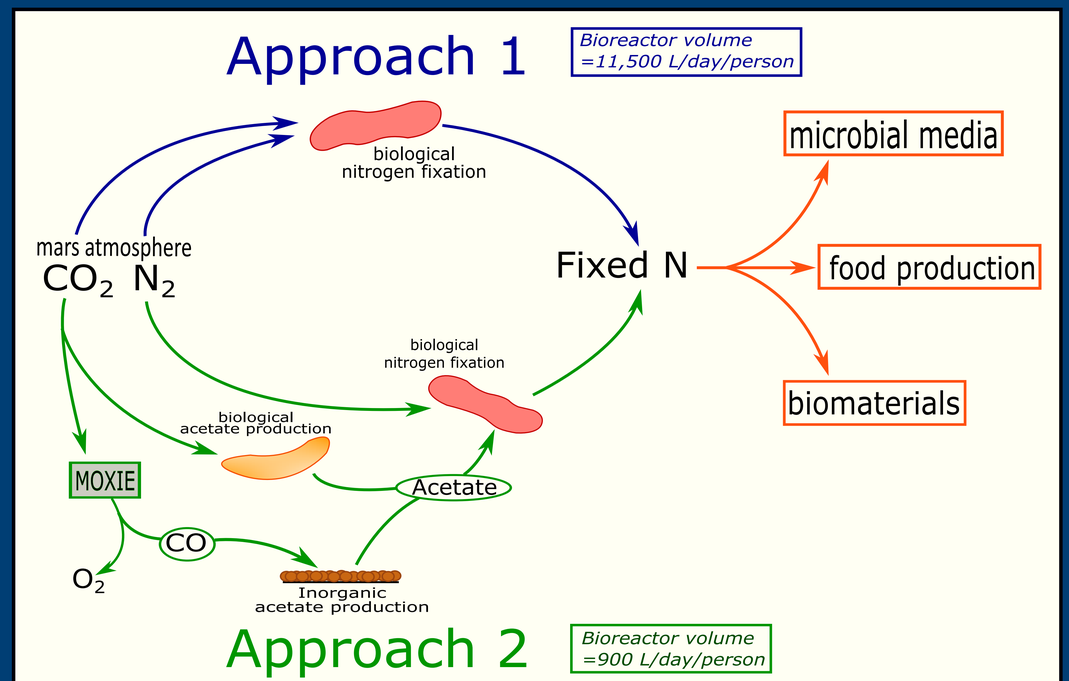
Results

	Autotrophic *R. palustris* TIE-1	*A. vinelandii*	*R. palustris* TIE-1	*R. palustris* CGA009 nifA* mutant
N-fixation rate (mmolar/day)	0.0934	5.44	2.23	2.55
Acetate consumption rate (mmolar/day)	N.A.	60	~6.2	~7.1
N-fixation reactor volume (L/person/day)	11,250	180	450	390
Acetate reactor volume (L/person/day)	150	790	~460	~500
Total reactor volume (L/person/day)	11,400	970	~910	~890

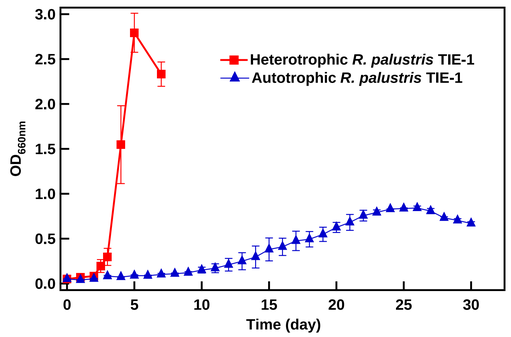
Future Directions

- Further characterization of the nitrogen fixation efficiencies in purple non-sulfur bacteria
- Explore the growth rates and nitrogenase activity in a co-culture of *R. palustris* nifA* and *S. ovata*

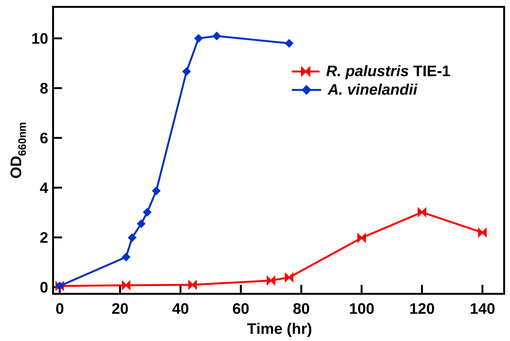
Significant increases in biological nitrogen fixation efficiencies as a result of acetate consumption relative to CO_2 fixation.



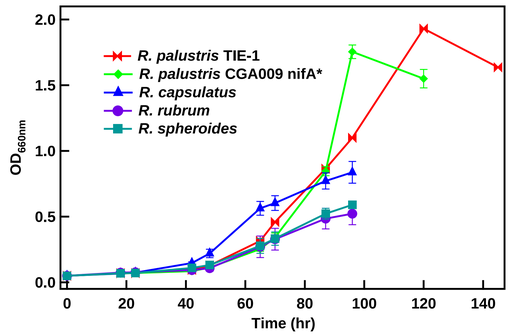
Autotropohic vs heterotrophic *R. palustris* TIE-1



A. vinelandii and *R. palustris* grown on acetate



Purple non-sulfur growth on acetate



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